

**POLLUTION  
(SO<sub>x</sub>, NO<sub>x</sub>, PARTICLES)  
TREATMENT**

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## **Pollution Treatment : SO<sub>2</sub> and NO<sub>x</sub> Removal Technology at Babcock-Hitachi**

### **ABSTRACT**

Babcock-Hitachi's impressive record of designing and building thermal power plants goes back more than 55 years ago. Babcock-Hitachi is also one of the foremost suppliers of environmental control equipment and this system provides the best protection with high reliability and economy. Babcock-Hitachi has built a solid base of R&D and design experience recognized throughout the world.

We began developing Flue Gas Desulfurization(FGD) systems since 1972. Today, Wet Limestone-Gypsum FGD systems are known as low-cost wet scrubbing systems, which use an easily obtained absorbent(limestone) and produce a high quality, commercial grade gypsum by-product. Our first commercial system(100MW plant) went into operation in 1974, furthermore a 1000MW plant started up in 1990. Consequently, our technology is now applicable to any kind of flue gas and covers a wide range of boiler capacities.

We began developing NO<sub>x</sub> removal systems from flue gas in 1963. Today Babcock-Hitachi is Japan's leading manufacturer of NO<sub>x</sub> removal systems, and many such systems have been delivered to North America, Europe and Asia where they are helping to control air pollution. This NO<sub>x</sub> removal system is called a Selective Catalytic Reduction(SCR) process, feeded NH<sub>3</sub> decomposes NO<sub>x</sub> into harmless N<sub>2</sub> and H<sub>2</sub>O on catalyst. This simple process both effectively removes NO<sub>x</sub> and is free from any by-products. It is thus easier to maintain and provides stabler continuous operation.

# BABCOCK - HITACHI

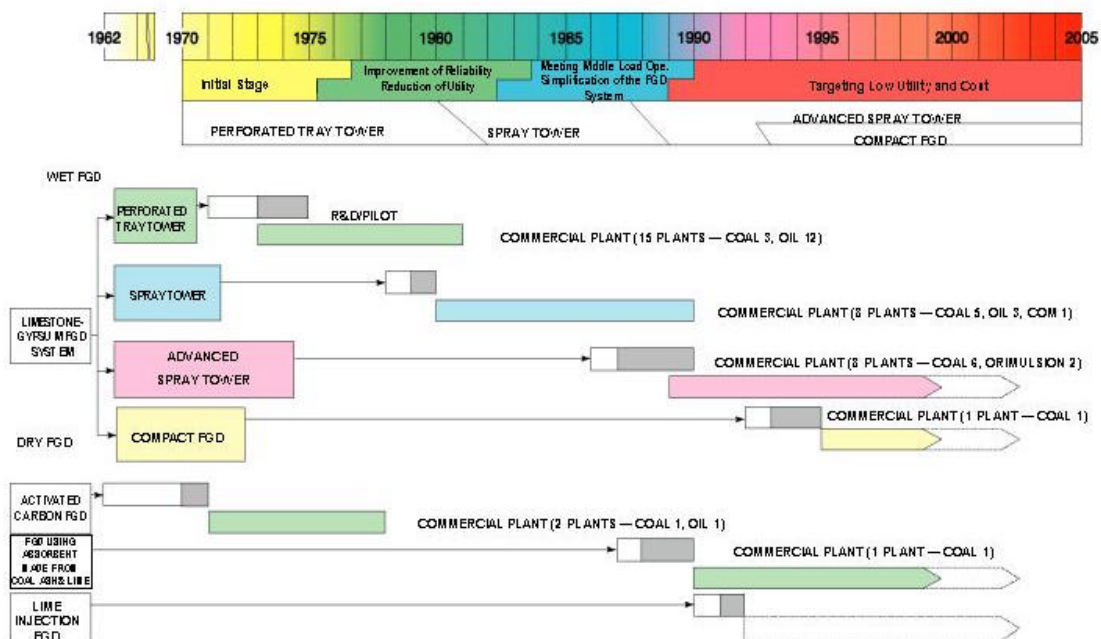
## FLUE GAS DESULFURIZATION (FGD) SYSTEM

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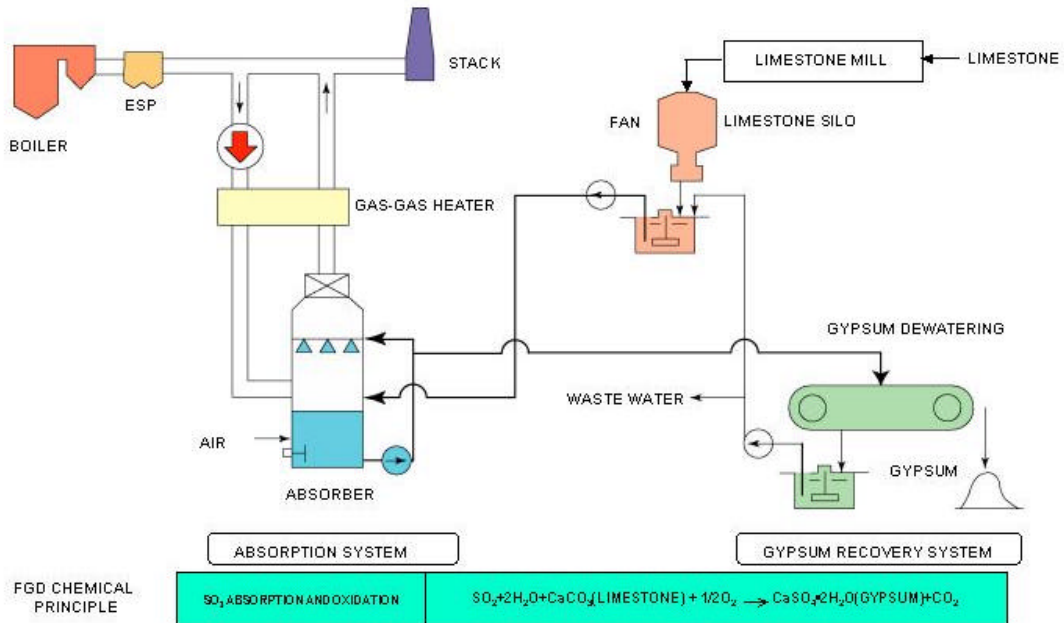
Babcock-Hitachi K.K.

### DEVELOPMENT OF BHK FGD SYSTEM



Babcock-Hitachi K.K.

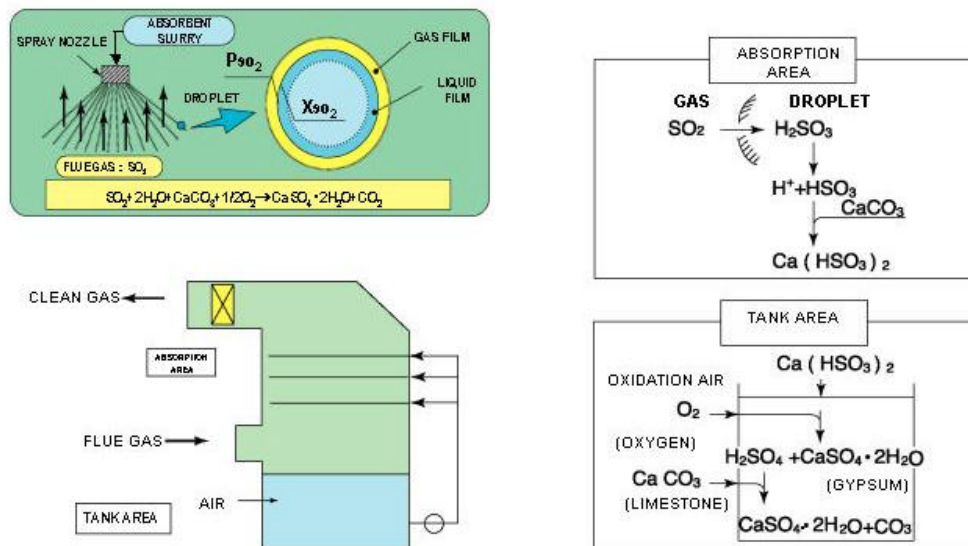
## PRINCIPLE & SYSTEM FLOW BHK WET FGD SYSTEM



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BHK 2

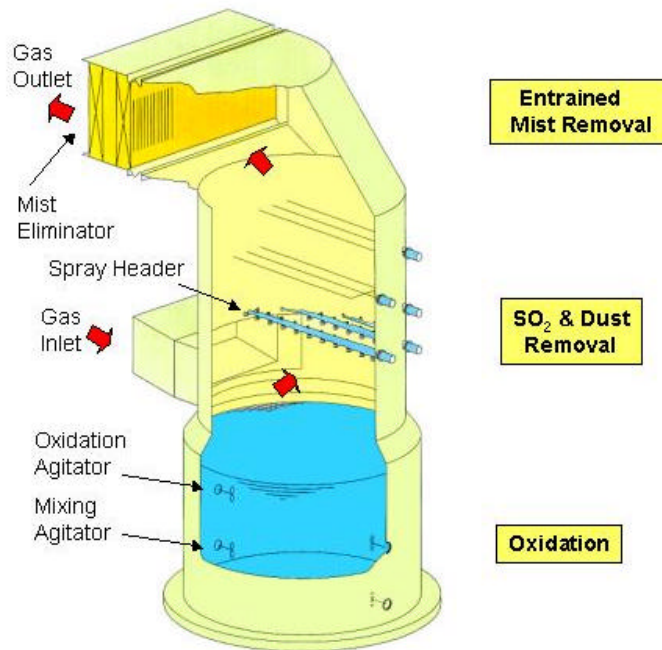
## PRINCIPLE OF BHK ADVANCED FGD SYSTEM



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BHK 3

## OUTLINE OF ADVANCED SPRAY TOWER ABSORBER

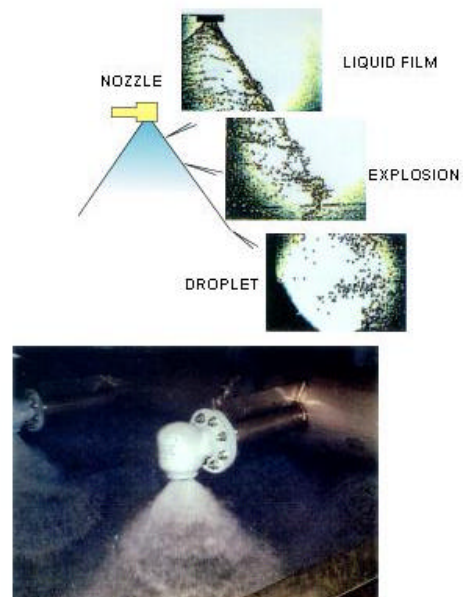
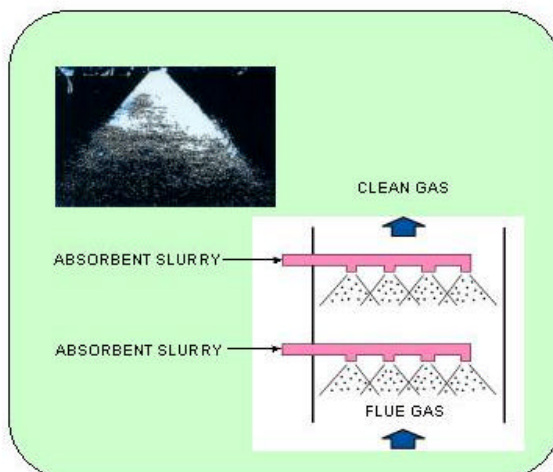


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BHK 4

## SOPHISTICATED SPRAYING METHOD

(High-performance Hollow Cone Nozzles for Wide Range of SO<sub>2</sub> Flue Gases)

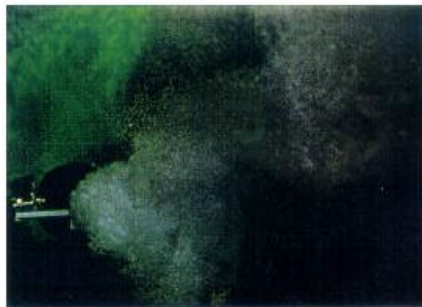
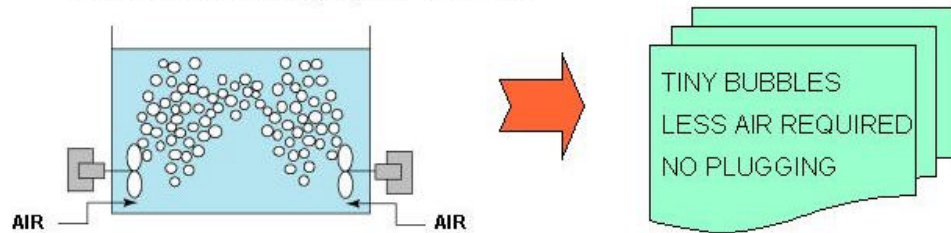


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## **EFFECTIVE IN-SITU FORCED OXIDATION METHOD**

- Effective oxidation by propeller atomizers



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## **APPLIED FUEL AND INLET SULFUR CONTENT**

FUEL	INLET SO <sub>2</sub> CONCENTRATION (ppm)				
	1000	2000	3000	4000	5000
BHK'S EXPERIENCE					
1. OIL					
2. COAL					
3. COM					
4. ORIMULSION					
5. RESIDUE OIL					
6. PETROLEUM COKE					

- Applied many kinds of fuel
- Experience of high sulfur containing fuel



BHK FGD can be applied to any kinds of fuel and high sulfur containing fuel



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BHK 8



## HIGH QUALITY OF BY-PRODUCT GYPSUM

### BY-PRODUCT GYPSUM QUALITY

ITEM	ACTUAL VALUE	GENERAL REQUIREMENT IN JAPAN	
		FOR CEMENT	FOR WALL BOARD
$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$	98.8 %	> 90 %	> 95 %
$\text{CaSO}_3 \cdot 1/2\text{H}_2\text{O}$	< 0.05 %	—	< 0.25 %
$\text{CaSO}_3$	0.32 %	—	—
$\text{Na}^+$	0.001 %	—	0.03 %
pH	6.8	—	5~8

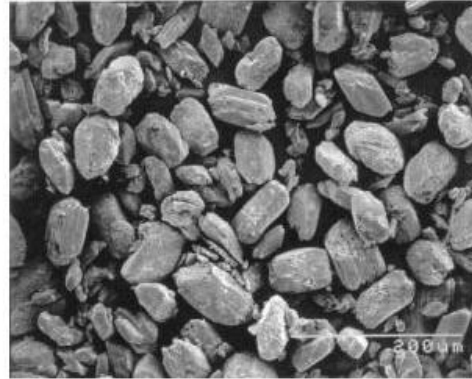


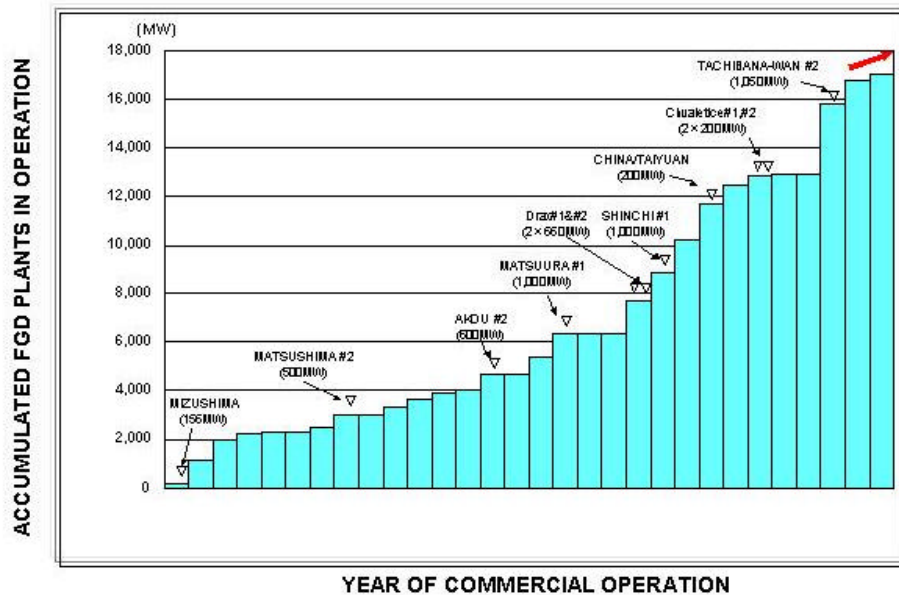
PHOTO OF BYPRODUCT GYPSUM CRYSTAL



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BHK-FGD-010-A

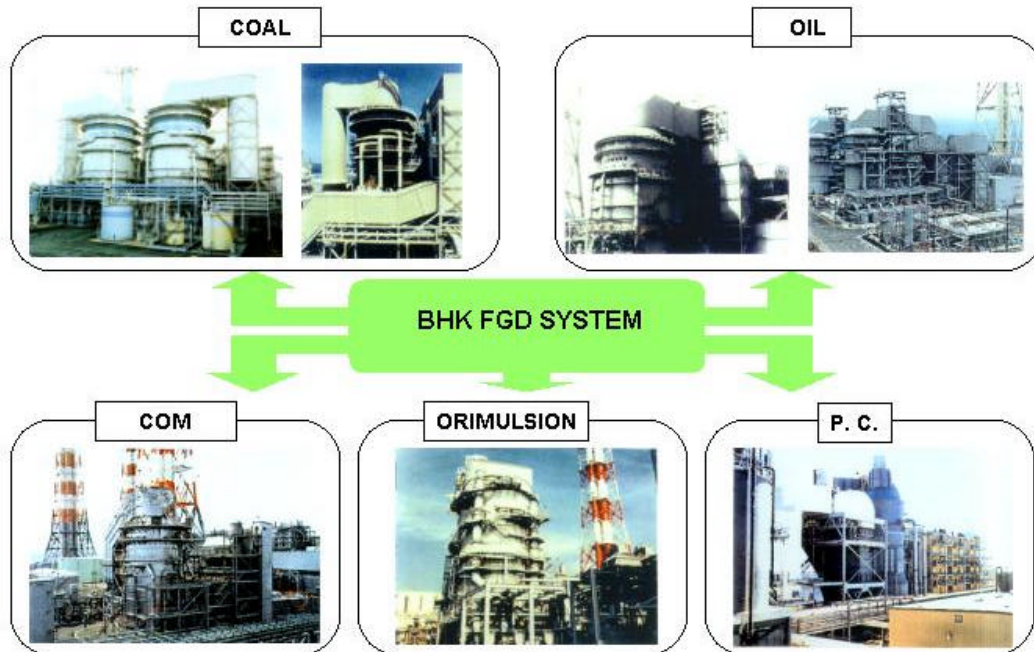
## ACCUMULATED FGD EXPERIENCE



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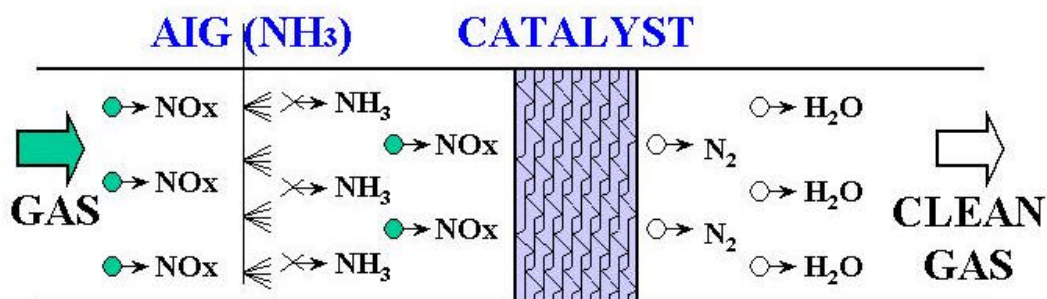
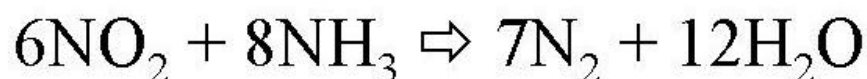
## **WIDE APPLICATION OF BHK FGD SYSTEM**



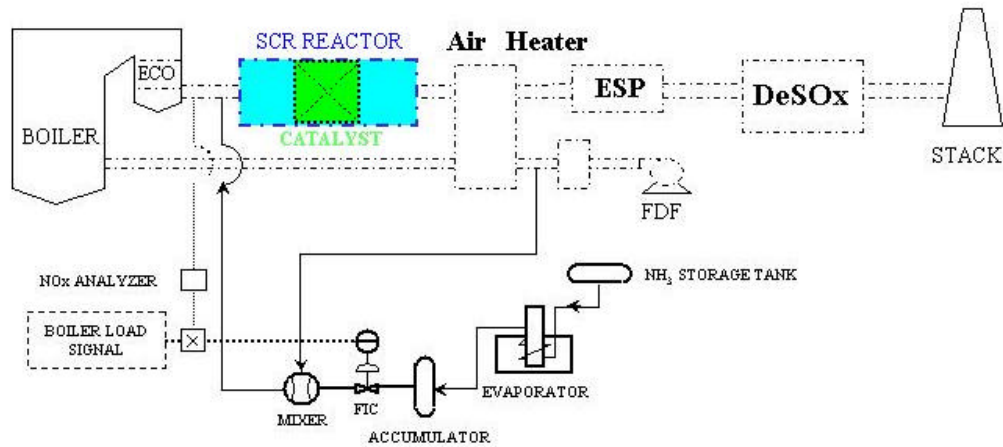
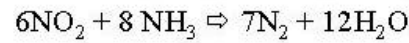
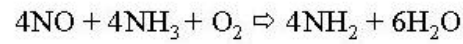


# SCR PROCESS

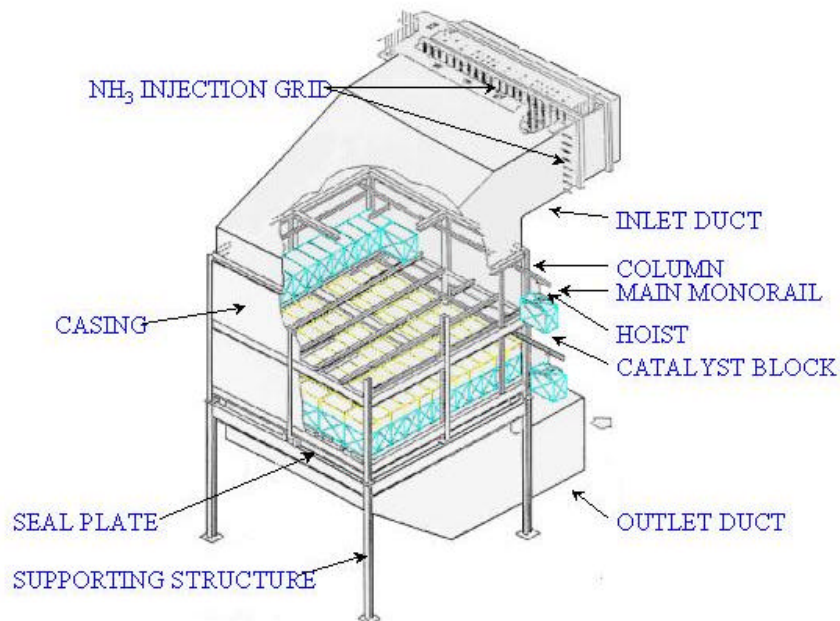
## NOx Removal System at Babcock-Hitachi



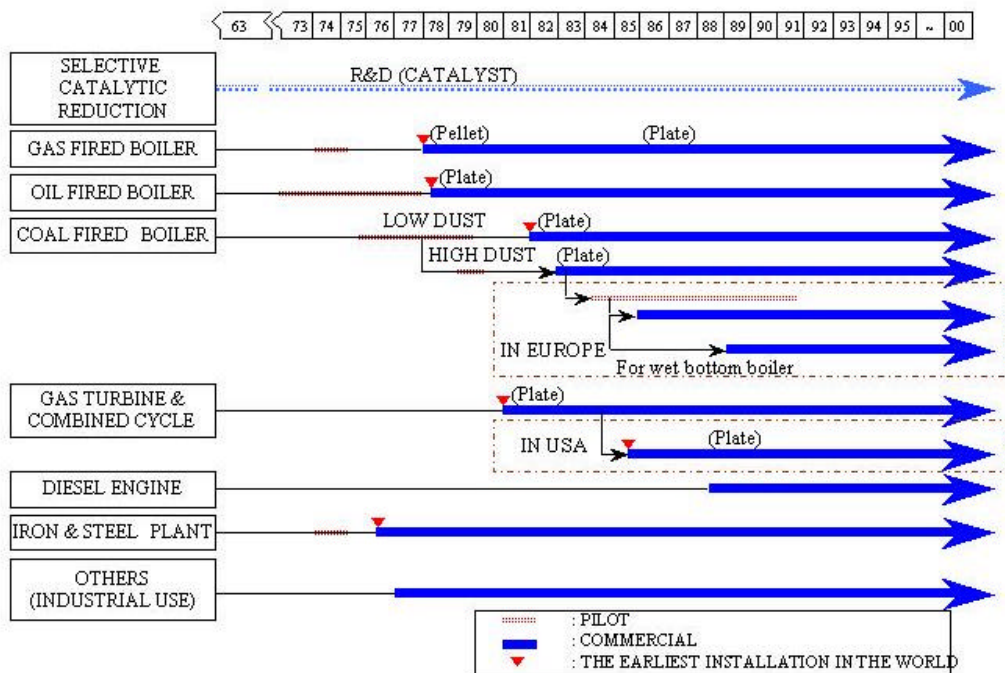
## PRINCIPLE OF SCR PROCESS



## SCR FLOW DIAGRAM

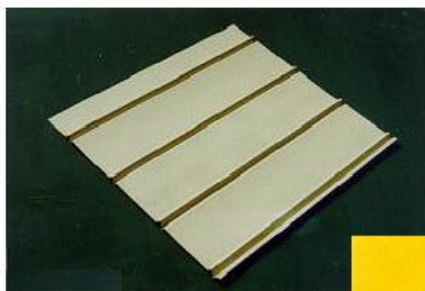


## SCR REACTOR CONFIGURATION



## DEVELOPMENT OF BABCOCK-HITACHI DeNO<sub>x</sub> PROCESS

### OUTLINE OF CATALYST



**CATALYST ELEMENT**  
(THICKNESS : Approx. 1mm)



**CATALYST BLOCK**



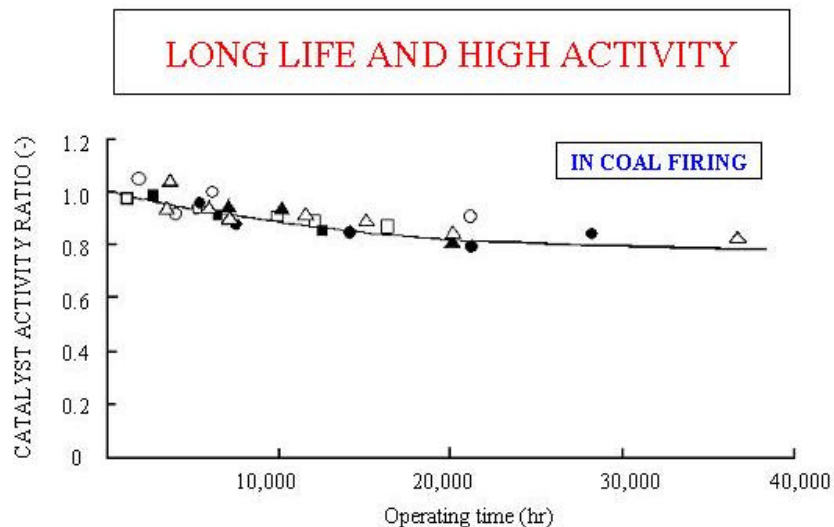
**CATALYST UNIT**  
Size : Approx. 500 x 500 x 500 (mm)

### Appearance of Plate Type Catalyst

## FEATURES OF HITACHI PLATE TYPE CATALYST FOR UTILITY BOILER

- ① HIGH ACTIVITY AND LONG LIFE (HIGH RELIABILITY)  
(COMPOSITION)\*
- ② HIGH EROSION RESISTANCE FOR DUST (COAL)  
(CENTER METAL PLATE IS APPLIED)\*
- ③ LOW POSSIBILITY OF DUST PLUGGING (COAL & OIL)
- ④ LOW PRESSURE LOSS (COAL, OIL & GAS)
- ⑤ COMPACT REACTOR BY MULTILAYER CATALYST STACKING
- ⑥ WIDE APPLICATION AND EXPERIENCES
- ⑦ HIGH QUALITY AND STABLE SUPPLY BY OWN FACTORY

\*BHK PATENTS

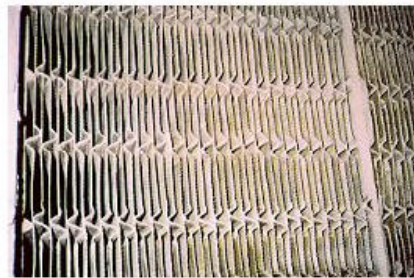


The figure shows the catalyst deterioration of sample catalyst inserted in commercial plants. The catalyst maintains a high level of activity over a long duration.

### ACTIVITY CHANGE OF CATALYST IN OPERATION



## HIGH EROSION RESISTANCE AGAINST DUST



These photographs show the conditions of catalyst edges installed to a coal fired boiler under high dust application.

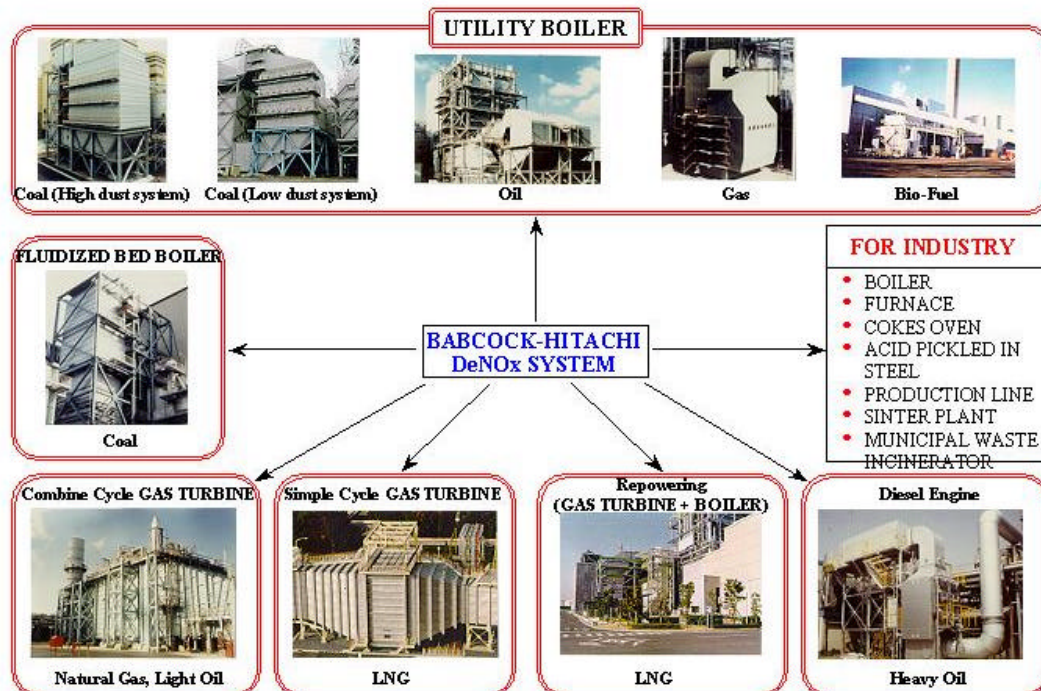
The catalyst has hardly eroded even after 50,000 hours in operation. (commercial operation start : 1983)

## PHOTOGRAPH OF CATALYST AFTER 50,000h OPERATING



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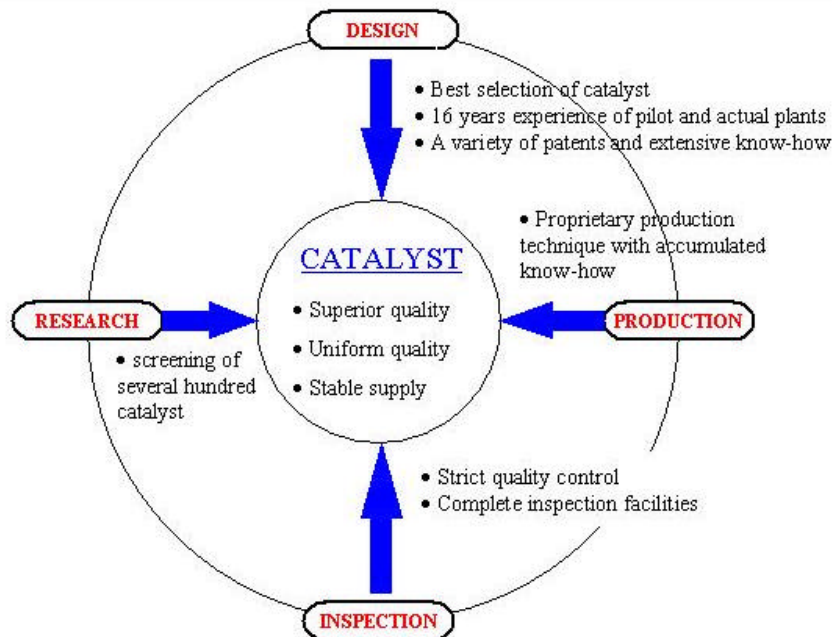
## WIDE APPLICATION OF BABCOCK-HITACHI DeNOx SYSTEM



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## TOTAL QUALITY CONTROL OF CATALYST AT AKITSU WORKS



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## CONCLUSION

Babcock-Hitachi's total flue gas treatment systems provide the best protection for environmental control with high reliability and economy. These environmental control systems easily meet the flue gas control requirements of almost any kinds of oil-, gas-, or coal-fired power plant.

### (1) FGD SYSTEM

Total Engineering Capability with Boiler Plant Engineering corresponding to various kinds of coal

Total Flue Gas Treatment Technology combined with ESP

Excellent Advanced Spray Tower Absorber Design

### (2) DENOx SYSTEM

High activity and long life because of high erosion resistance for dust

Low possibility of dust plugging and low pressure loss

Wide application and experiences owing to stable supply by own factory

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